Trout Stocking Rates: A Wyoming Perspective

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Abstract

Stocking hatchery-reared trout *(Salmonidae)* in inland waters has always been an important facet of fisheries management. Late 19th and early 20th Century trout stocking in Wyoming and elsewhere in North America focused primarily on improving fishing and attracting more fishing-based tourism. Like annual reseeding of agricultural crops, fisheries pioneers believed annual trout stocking was necessary to sustain good fishing. Little attention was paid native nongame fishes or to maintaining biological diversity of fish assemblages. Stocking rates – trout per acre – varied greatly and were based on trial and error, personal preference, or calculated according to a wide variety of stocking models. Wyoming trout streams sustain standing stocks at or near productive capacity; 45% of stream trout stocks exceed 60 pounds per acre, 20% exceed 120 pounds per acre and only 10% of stream trout populations sustain more than 200 pounds per acre. Wyoming recommends stocking rates >200 subcatchable trout per acre for new impoundments, less for other waters. Natural productivity of waters, not public opinion, best guides fisheries managers in determining appropriate numbers of fish to stock in candidate waters. Trout stocking rates at or near 200 subcatchable trout per acre produce good results. The Wyoming experience indicates that stream trout standing stocks do not significantly increase by stocking subcatchable size trout, number stocked notwithstanding. Return to anglers of lake-stocked subcatchables is more a function of lake productivity than fishing pressure; best returns are from lakes of moderate depth (20 to 50 feet), with lowest return from deep (≥100 feet), oligotrophic lakes or waters with competing coolwater species or piscivorous trout. It is our job as modern, competent resource professionals to explain our fisheries management recommendations, including trout stocking, to constituents and provide a sound understanding of how lake and stream fisheries work – instilling in anglers a sensible philosophy of fisheries resource management, resulting in a more effective, beneficial resource management relationship.

Introduction

As a rookie fisheries biologist, stocking hatchery-reared trout was among my earliest responsibilities. We stocked mostly rainbow trout *Onchorhynchus mykiss* in lakes and streams near Pinedale, Wyoming that summer of 1962. Others had planned the stocking and I thought little about number stocked other than making sure fish arrived in good condition and were safely deposited in their new home. The following year, nearly 3 million rainbow trout were stocked in newly impounded, 42,000 acre Flaming Gorge Reservoir in southwestern Wyoming and northeastern Utah. A very good fishery resulted. About the same number of rainbow trout were stocked annually through 1965, but because trout condition had declined substantially by fall, we reduced stocking by 60% for 1966. Rainbow trout condition rebounded and all was well until Utah chubs *Gila atraria* began competing with trout for zooplankton and dominating gillnet catches late in the 1960s and early 1970s.

Reasons for poor rainbow trout condition in fall1965 and the companion die-off in the mid portion of the reservoir, despite abundant zooplankton, were unclear, although much discussed. The situation was complicated because of an enormous, companion bloom of the blue green algae, *Aphanizomenon flosaquae,* a species sometimes associated with fish kills. Could too many rainbow trout have been stocked? I believe so, even though the 42,000-acre reservoir was only 3 years old, but that is a story for another time.

Historical Background

The initial footprints of Wyoming fisheries management were regulation of fishing, development of fish culture and trout stocking. The first Territorial Legislature (1869) defined hook and line as legal fishing tackle but set no angling season, creel, or possession limit. An 1875 statute indicated that wildlife could be taken in amounts reasonable for human sustenance, recognizing fish harvest as a beneficial resource use. At the time only native cutthroat trout *Oncorhynchus clarki* inhabited the state's waters. A Territorial Fish Commissioner, appointed in 1879, was charged with controlling fishing and stocking fish. The first introduced trout (brook trout *Salvelinus fontinalis)* arrived by rail in 1880.

A Board of Fish Commissioners, authorized in 1882, controlled and supervised collection, propagation, distribution, and protection of fish. Their motivation was profit. The Board approved the first fish hatchery in 1883 (production began in 1884) believing that many waters were either devoid of trout (the North Platte River drainage had no salmonids) or that populations had been extirpated by dams without fishways, unscreened water diversions, use of explosives or poisons, and overfishing. Board consent was necessary for construction of dams or water diversions and fishways were required to allow fish unobstructed access to all waters. Legislators had the right idea but many streams were cleared of natural habitat features – like woody debris and large boulders - to facilitate floating railroad ties to market. The consent law was repealed in1932.

From the time of the first Wyoming Fish Commissioner (1879), resource management emphasized better fishing, introducing new game fishes to create more fishing, and building fish hatcheries to improve trout populations to attract more fishing-based tourism (Barkwell 1883; Miller 1890). From this beginning and for about the next 80 years the traditional fisheries mission was providing fish for anglers by the most expedient means. Often anglers benefited at the expense of native, self-sustaining trout and other native fishes. People were aware of fish other than trout, but more complex management goals like maintaining ecological diversity of fish assemblages seldom received due consideration.

Fisheries managers everywhere have sought to enhance trout populations by stocking, hoping for better fishing and more satisfied anglers. Wyoming Fish Commissioner J. J. Lenihan (1914) wrote that most Wyoming waters sustained wild [native cutthroat] trout or trout that had been stocked, but he believed that increased stocking of hatchery-reared trout would increase trout populations and improve fishing. Fifteen years later (1929), the eight state-owned hatcheries were producing 20 million fingerling trout for stocking. By 1931, even that amount of production was purportedly insufficient to supply increasing demand for fishing. Much of resource management focus remained on producing hatchery-reared trout for stocking, fueling the quest for ever better fishing. Fish Chief A. F. C. Greene (1950) boldly recommended emphasizing management for wild trout and closed many of the state-sponsored trout rearing ponds – despite public and political criticism - because they produced less than one-third of what was expected.

Wyoming's first fisheries biologists came aboard in 1950 and, as the decade matured, they paid more attention to native trout and other native fishes that sustained no angling. For example, the Jackson fisheries crew focused on the Snake River cutthroat trout subspecies *Oncorhynchus clarki* spp. from its inception, several state-private partnership rearing ponds were eliminated because they yielded trout far below anticipated production, and the Laramie crew reintroduced orangethroat darter *Etheostoma spectabile* to native streams following chemical removal of nonnative nuisance species. Those actions were farsighted for a time when it seemed that most fisheries biologists were solely responsible for maximizing angler satisfaction.

Stocking hatchery-reared trout is important. Hobbs (1948), describing the role of fish culture in the development and management of New Zealand's trout fisheries, said that the New Zealand hatchery system was over 70 years old, meaning that most anglers were born to it, had accepted it, and believed it essential to the well being of their fisheries. After almost 70 years (1884-1950) of trout stocking, Wyoming fisheries biologists realized that anglers generally believed that good trout fishing required annual stocking – much like annual reseeding of agricultural crops.

Wyoming fish culture remains vital to maintenance of quality trout fisheries; today, 10 fish hatcheries produce nearly 9 million trout annually. About 85% of this production is stocked in lakes, the rest in streams. How well do stocked trout return to anglers? Those stocked in streams survive and return best when numbers of competing trout (wild or carryover planted) are low. Even then, a mean of only 5.7% of the number of hatchery-reared subcatchable (<8.25 in) and 27.5% of the number of catchable-size (≥8.25 in) trout stocked in streams return to anglers (Wiley et al. 1993).

Results of stocking trout in Wyoming lakes is less problematic, with returns ranging to about 20.0% (mean 11.1%) of number stocked for hatchery-reared subcatchable to over 90.0% (mean 47%) of number stocked for catchable-size trout (Wiley et. al. 1993). Return to anglers of lake-stocked subcatchables is more a function of lake productivity than fishing effort; best returns are from lakes of moderate depth (20 to 50 feet), with lowest return from deep (≥100 feet), oligotrophic lakes or waters with competing coolwater species (e.g. walleye *Sander vitreus*) or piscivorous (e.g. lake *Salvelinus namaycush* or brown *Salmo trutta*) trout. Return of catchable-size trout depends almost entirely on fishing effort, assuming no environmental problems.

Most Wyoming streams, except tailwaters, are managed as self-sustaining fisheries because years of experience have shown that stocking trout in streams does not increase trout populations beyond stream production capacity. Platts and McHenry (1988), studying streams in seven western ecoregions, found standing stocks ≤60 pounds (trout and char) per acre were most common (55 to 96% of observations) for streams across all seven ecoregions, suggesting that streams sustain trout to carrying capacity. About 55% of estimated trout stocks in Wyoming streams are ≤60 pounds per acre, 80% are ≤120 pounds per acre, and 90% are ≤200 pounds per acre; only 10% of Wyoming streams have trout standing stocks greater than 200 pounds per acre (Wiley 1992). Wyoming has stocked trout in streams for more than 120 years without significantly increasing trout populations above the level of self-sustaining trout stocks, number of subcatchable-size trout stocked notwithstanding. Now stream stocking in Wyoming takes place almost exclusively in tailwaters.

Guidelines for Stocking Rates - Trout per Acre - for Lakes and Streams

Review (1992) of trout stocking guidelines for eight states and two Canadian provinces showed wide variation in methods used to determine trout stocking rates per lake or stream acre (sometimes per stream mile). Trout stocking rates vary throughout North America based on assessment of many chemical, physical, and biological factors. For example, rate may vary with elevation, water temperature, expected post-planting growth rate, size at stocking, fishing effort, expected (desired) harvest, habitat quality, estimated production capacity for wild and stocked trout or virtually any combination of factors, including trial and error (Heidinger 1999). Politics, economics (stocking attracts more anglers), and societal opinion also influence trout stocking recommendations. Clawson (1963) was right; conservation agencies cannot escape responsibility for public perception of fishing quality because their actions largely created it.

Guidelines are useful references in fisheries management decisions, including determining number of trout to stock per surface acre. Until 1994 Wyoming had no such written guidelines; stocking rates varied widely, and were based chiefly on experience, personal preference or any of several stocking models employed by other states. A committee of Wyoming fisheries biologists developed guidelines for stocking trout (number per acre) based upon expected fishing effort and biological potential for trout production (Table 1, example for put-grow-and-take standing water fisheries; Table 2, example of biological potential information).

Table 1. Stocking rates (trout per surface acre) for put-grow-and-take standing water fisheries using Size 2 (1.25 to 3.00 inch) and 3 (3.25 to 5.00 inch) trout.

Fishing effort	Biological potential			
(hours/acre/year)	Low	Fair	Good	Excellent
Low (≤25)	<25	25	50	75
Moderate (25-75)	75	125	175	*200
High (<75)	125	175	*200	*200

**Formerly 225 to 350 trout per acre. Rates that high are suggested only for new waters or those out of production for a year or more. Stock one or two years at the high rates, thereafter at rates illustrated. Return rate to anglers of one pound per each pound of trout stocked indicates a successful stocking program for Size 2 and 3 trout.*

Table 2. Biological potential: information applies to stocking guidelines for put-grow-and-take fisheries.

Component	Definition		*Score
Competition	No competing fish species; trout only		5
	Few competing fish species		4
	Moderate number of competitors		2
	Competitors abundant		0
Productivity (TDS)	Excellent for trout growth	(TDS ≥200 mg/l)	10
	Good	(TDS 100-200 mg/l)	8
	Fair	(TDS <100 mg/l)	5
	Low	(TDS ≤40 mg/l)	2

**Scores for Competition and Productivity are summed. The following scores indicate Excellent, Good, Fair and Low biological potential as shown in Table 1.*
Excellent: 14-15 Good: 11-13 Fair: 8-10 Low: <8

Stocking rates >200 trout per acre are recommended for new impoundments, less for other standing waters. High (>200 trout per acre) stocking rates sometimes remain for years because fishing remains good with no perceived need to achieve the same result with fewer fish. Fisheries managers should consider lower stocking rates, particularly for waters stocked at rates above 200 trout per acre.

Wales and Borgeson (1961), working 48-acre Castle Lake, California, found that stocking rainbow trout fingerlings (210 per acre) increased yield by only 1.4 pounds per acre over that of self-sustaining brook trout. Increased yield cost about US $1.26 (1961 dollars) per additional pound yielded. Moreover, heavy stocking established a rainbow trout population at the expense of self-sustaining brook trout that steadily declined after rainbow planting began. Could brook trout have sustained good fishing and satisfied anglers? The self-sustaining brook trout population would certainly have been on balance with lake productivity and less costly. Perhaps fisheries managers sought to diversify the Castle Lake fishery or simply enhance it by introducing rainbow trout.

Klein (1976) observed that natural productivity could best guide fisheries managers in providing fishing in many productive, heavily fished Colorado waters, resulting in more efficient and cost effective management. Colorado decided otherwise, increasing production and stocking rates of hatchery-reared, catchable-size trout. Results showed that return to anglers was best (about 88% of number planted) when stocking of catchable-size trout was light (250 per acre) and that high stocking rates (>750 per acre) produced lowest return (about 66% of number planted) to anglers (Klein 1976).

Bentz et. al. (1991) studied stocking rates of 100, 200, 400, 800, and 1,000 rainbow trout per acre for inland south-central Alaska streams and found decreased survival to one year post-stocking with increasing stocking rates. They recommended stocking no more than 200 rainbow trout per acre for best economy and return of stocked fish to anglers. Platts and McHenry (1988) had it right when they said that streams sustain trout up to their natural production capacity.

Trout must find suitable places to live, feed, rest, and reproduce, post-stocking in lakes or streams. Where those habitat elements are abundant, large populations of trout are expected and where they are limited, trout populations are smaller but on balance with habitat. Wyoming experience indicates that stream trout standing stocks do not significantly increase by stocking subcatchable size trout, regardless of number stocked.

Now Therefore, What?

Mullan and Goede (1976) said that when early fish culture proved not an obvious remedy for diminishing fish stocks, fisheries biologists were hired as a sop to public demands for better fishing. The ensuing partnership of fisheries management and fish culture produced credible success over the intervening years. Solid achievement notwithstanding, traditional views of fisheries biologists as low-priced, interchangeable assembly-line cogs and the ever-present need for "good public relations," in spite of what makes resource sense became institutionalized. Results of the modern dogma of asking the public what they want and then providing it are all too self-evident (Mullan and Goede 1976).

Klein (1976) got it right – natural productivity of waters can best guide efficient and cost effective fisheries management, including trout stocking. It is our job as modern, competent resource professionals to explain our fisheries management recommendations to constituents to provide a sound understanding of how lake and stream fisheries work – instilling in anglers a sensible philosophy of fisheries resource management, resulting in a more effective, beneficial resource management relationship.

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